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A STUDY OF INFANT AND MATERNAL DEATH RATES IN A WESTERN STATE.

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GEOGRAPHY.

Montana lies between the 45th and the 49th (the Canadian border) parallels of latitude and the 104th and 116th meridians of longitude; it averages 275 miles in width from north to south and 535 miles in length from east to west; and it is the third largest State in the Union, containing 146,997 square miles.

At the time of the 1920 census it had 51 counties. The areas of these in square miles varied as follows: One was 7,146 square miles, one 6,446, five between 5,000 and 6,000, four between 4,000 and 5,000, seven between 3,000 and 4,000, fifteen between 2,000 and 3,000, fourteen between 1,000 and 2,000, and four between 500 and 1,000.

By way of comparison, the area of New Jersey is 8,224 square miles, that of Connecticut 4,965, of Delaware 2,370, and of Rhode Island 1,248.

The State is traversed from east to west by three transcontinental lines, with connections and branches which supply remarkably adequate railway communication between all the larger towns and cities and most of the villages. However, four counties in the eastern part of the State, varying in area from 3,350 to 5,350 square miles, are without any railway facilities. Lack of railway facilities in the greater portion of the State is compensated for by good highways, which afford automobile transportation throughout the entire year, with the exception of a few weeks. But the impassibility of the roads during these few weeks of winter often constitutes a serious difficulty in providing adequate and immediate medical or nursing care to remote settlements often 50 to 100 miles from urban centers.

TOPOGRAPHY.

The name "Montana," meaning mountainous, is descriptive of the topography of a large part of the State. The western third consists of the main range of the Rocky Mountains, forming the continental divide, which cross somewhat diagonally from west of north to east of south. The eastern two-thirds of the State is made up of plains and plateaus, broken by many buttes and occasional small mountain ranges. These latter frequently interfere with direct communication between points and necessitate long detours in travel.

One-fourth of the State lies at an altitude of less than 2,000 feet, one-half is less than 3,000 feet in altitude, and three-fourths less than 4,000 feet. The highest altitude is 12,000 feet, and the average 3,400 feet.[1]

CLIMATE.[2]

Temperature and rainfall of different parts of the State are materially affected by the main divide of the Rocky Mountains. On the western slope the precipitation is heavier and the extremes of temperature are less marked. The effect of coast currents extends over the divide for some distance, the "chinooks," or warm winds, being felt as far as 300 miles east of the crest of the mountains. In the western valleys minimum temperatures of —20° to —25° are comparatively rare, whereas on the plains it is not unusual to experience extremes of —40° to —45°. But low winter temperatures, as a rule, do not continue for long periods, and are accompanied by dry and a comparatively calm atmosphere, which renders them more endurable to animal life than much higher temperatures with these conditions absent. Outdoor occupations can be carried on with little interruption or discomfort during winter and spring months.

Summer temperatures, on the other hand, are never oppressive. Although there are a few days in one or more of the summer months when a maximum temperature of 90° or above is recorded in the mountain sections and of 100° or above on the plains, the temperature cools rapidly in the evening by radiation, and there are, therefore, no hot nights.

The mean annual temperature is 42.4° F.

The greatest precipitation occurs during the summer months. The precipitation in the months of May to August, inclusive, nearly equals that for the remaining eight months. About one-half the State receives from 10 to 15 inches annually and the remainder from 15 to 25 inches. Amounts of 20 inches or more fall over limited areas at lower altitudes, principally in the northwestern portion of the State. The greatest annual precipitation for the State as a whole was in 1908, viz, 61.81 inches; the least was in 1919, viz, 4.54 inches.

INDUSTRIES.

Probably no State has a wider variation of natural resources. They consist of metal mines of copper, gold, silver, lead, and zinc, with their attendant refining or smelting processes, bituminous coal mines, oil-producing districts, stock raising, agriculture in irrigated and nonirrigated areas, horticulture, lumbering, and water-power developments. Each of these industries has had a distinct influence on immigration and population characteristics, and these influences must be determined by acquaintance with the history of development of each industry.

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[1] Thirteenth Annual Report, U. S. Geol. Survey, Part II.

[2] Bulletin Q, U. S. Weather Bureau.

Although, in common with all portions of the United States, all of these industries suffered from the economic reaction following war-time prosperity, the depression was more marked in agricultural and stock-raising centers. A series of short crops for several preceding years culminated in a severe drought in 1919, resulting in almost complete financial failure of several thousands of homesteaders and stockmen in nonirrigated areas. There occurred a large emigration from these districts, especially of those who, inexperienced in agricultural pursuits, were unwilling or unable to face the hardships incident to pioneering. Among those who elected to remain, there arose great need for financial and social relief, and State and local agencies, both governmental and extragovernmental, were strained to meet the emergency.

POPULATION.[3]

According to the census, the population of Montana, as of January 1, 1920, was 548,889, which represented an increase of 172,836, or 46 per cent, since 1910. The greatest part of this increase occurred in that part (approximately three-fifths) of the State lying east of the main range which in the past decade has witnessed an influx of homesteaders.

The density of population varied from one inhabitant per square mile in Powder River County, a ranching and stock-raising district, to 86.4 inhabitants per square mile in Silver Bow County, a mining community. The average number of persons to the square mile for the State was 3.8. Including both urban and rural populations, 18 counties averaged less than 2 persons to each square mile, 32 counties from 2 to 6 persons, 5 counties from 6 to 18 persons, 1 county from 18 to 45 persons, and 1 from 45 to 90 persons. Omitting urban population, rural inhabitants for each square mile averaged less than 2 in 18 counties, 2 to 6 in 32 counties, and from 18 to 45 in 1 county.

The urban population was grouped in 12 cities of over 5,000 population and 5 other cities of over 2,500 population, and comprised 31.3 per cent of the total.

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[3] Fourteenth Census of the United States: 1920. Bulletin: Montana. Bureau of the Census.

Racial composition of the total population was—

	Number.	Per cent.
White	534,260	97.3
Negro	1,658	.3
Indian	10,956	2.0
Chinese	872	.2
Japanese	1,074	.2
All other	69	[1]
Native white	440,640	80.3
Foreign-born white	93,620	17.1

[1] Less than one-tenth of 1 per cent.

Males outnumbered females by 50,993, the ratio for the total population having been 120.5 males for 100 females. In the native white population the ratio was 112.6 males for each 100 females, and in the foreign-born whites 164.5 males for each 100 females.

By race the ratios of males to 100 females were as follows: White, 120.2; Negro, 138.2; Indian, 107.6; Chinese, 1,201.5 (805 males to 67 females); Japanese, 362.9.

These ratios should be considered in a study of birth rates.

The total number of women of child-bearing age (15 to 44 years) was 121,589.

BIRTH RATES.

Since infant and maternal death rates are the ratios between infant and maternal deaths and the total number of living births, their accuracy depends upon the completeness with which births are reported. The adequacy of birth registration must first be established.

The Montana vital statistics law was enacted in 1907 and became operative that same year. The State was admitted to the United States death registration area in 1910 (to the birth registration area in January, 1922).

The number of living births registered in 1919 was 12,017; in 1920, 11,862.

On the estimated increase of population based on the 1910 census the birth rate for 1919 was 24.1 per 1,000 population. Since the same estimate of increase was used as a basis of population calculation for other States in the birth registration area, for comparative purposes it must be used. On this premise Montana would have ranked sixth among these States. However, on the actual increase of population, as revealed by the 1920 census, the rate was somewhat lower, being 22.3, or equivalent to that of the United States registration area, and would have given the State a ranking of twelfth among the States of that area.

Birth rates per 1,000 population, 1919.

United States Birth Registration Area, 22.3.

Utah	29. 3	Minnesota	21. 9
North Carolina	29. 1	New York	21. 9
South Carolina	26. 6	Wisconsin	20. 9
Virginia	26. 5	Kansas	20. 6
Connecticut	24. 8	Indiana	20. 3
Montana[4]	24. 1	Maine	20. 2
Kentucky	24	Vermont	19. 9
Pennsylvania	24	New Hampshire	19. 8
Maryland	23. 6	Ohio	19. 8
Michigan	23. 2	Washington	18. 7
Massachusetts	22. 9	Oregon	17. 4
Montana[5]	22. 3	California	16. 8

The rate for 1920 was somewhat lower, being only 21.3 as against the United States birth registration area rate of 23.7, and would have given the State a ranking of nineteenth among the States of the area. Decline of the 1920 rate was to a considerable extent influenced by emigration of many homesteaders with families, following temporary agricultural depression brought about by the reduced rainfall in 1919.

Birth rates per 1,000 population, 1920.

United States Birth Registration Area, 23.7.

North Carolina	31. 6	New York	22. 5
Utah	31. 1	Maine	22. 5
Virginia	28. 3	New Hampshire	22. 4
South Carolina	28. 2	Kansas	22. 3
Kentucky	26	Wisconsin	22. 2
Pennsylvania	25. 1	Indiana	22
Michigan	25	Montana	21. 3
Maryland	24. 8	Ohio	21. 3
Connecticut	24. 5	Vermont	21
Nebraska[6]	23. 7	Washington	19. 8
Massachusetts	23. 6	California	19. 3
Minnesota	23. 3	Oregon	18. 9

In view of the excess of males over females, and compared with registration States west of the Mississippi River, and more especially with immediate neighbors subject to similar factors of population movements, it would seem that rates for both years can be regarded as satisfactory indication of fairly complete registration.

While there is a partial failure to secure complete registration in remote rural areas, the actual percentage unreported is small. For the most part, the showings of reduced rates occur in those counties in which distance from medical service and inadequate transportation facilities encourage mothers to seek hospital centers. Counties with hospital facilities show corresponding increases of rates. This factor is emphasized by the marked difference in urban and rural rates, as follows:

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[4] Rate based on estimated increase of population from 1910 census.

[5] Rate based on actual increase of population as shown by 1920 census.

[6] Admitted to birth registration area, 1920.

1919—Urban rate	28. 8	1920—Urban rate	29. 1
Rural rate	18. 7	Rural rate	18. 2

The standard form of birth certificate was not adopted until July 1, 1919, and since the post card previously in use omitted several items of information contained on the standard form, it is impossible to present as full tabulation for 1919 as for 1920.

The following table of 1920 data is of interest:

Births per 1,000 enumerated female population.

Race.	Registration area, 1920.	Montana.	
		1919	1920
White	48. 2	48. 1	47. 2
Native white	42. 8	....	41. 8
Foreign born white	....	....	62. 3
Indian	48. 3	48. 3	63. 8
Negro	52. 8	34. 5	14. 4
Yellow (Chinese and Japanese)	....	153. 8	204. 0
Total	48. 6	48. 2	47. 6

INFANT DEATHS.

The number of deaths of children under 1 year of age during 1919 was 955, and in 1920, 842. These figures constitute infant mortality rates (per 1,000 living births) of 79.4 in 1919, as compared with a rate of 87 for the United States Registration Area, and 70.9 in 1920, as compared with 86 for the registration area.

Of the 22 registration States in 1919, one State (Indiana) recorded the same rate, six States (Utah, California, Kansas, Minnesota, Oregon, and Washington) had lower rates, while 15 States exceeded the rate. Of 27 registration States in 1920, 1 State (Utah) recorded the same rate, 4 States (Minnesota, Washington, Nebraska, and Oregon) had lower rates, while 18 exceeded it.

Infant death rates per 1,000 living births, 1919.

United States birth registration area, 87.

South Carolina	113
Maryland	105
Pennsylvania	100
New Hampshire	93
Maine	91
Virginia	91
Michigan	90
Ohio	90
Massachusetts	88
Connecticut	86
Vermont	85
North Carolina	84
New York	84
Kentucky	82
Wisconsin	80
Indiana	79
Montana	79
Utah	71
California	70
Kansas	70
Minnesota	67
Oregon	63
Washington	63

The rate per 1,000 women of child bearing age (15-44) in Montana in 1919 was 98.6, and in 1920, 97.5.

Infant death rates per 1,000 living births, 1920.

United States birth registration area, 86.

South Carolina	116	Ohio	83
Maryland	104	Indiana	82
Maine	102	Wisconsin	77
Pennsylvania	97	California	74
Vermont	96	Kansas	73
Connecticut	92	Kentucky	73
Michigan	92	Montana	71
Massachusetts	91	Utah	71
New Hampshire	88	Minnesota	66
New York	86	Washington	66
North Carolina	85	Nebraska[7]	64
Virginia	84	Oregon	62

Variations between urban and rural infant mortality rates in Montana are not marked:

	1919	1920
Urban rate	79.8	71.7
Rural rate	79.2	70.4

A slight advantage would seem to accrue to rural districts. This may be due to slight extent to failure to secure complete records of some neonatal deaths in remote regions, where necessity for careful recording has not been fully appreciated; but the tendency of many rural mothers to seek hospitals in urban centers during confinement and for brief postnatal care is probably the greatest factor leading to the higher urban rate. If these latter could have been segregated it is probable that the ratios would have been about equal or slightly the reverse.

Death rates among male infants exceed those in females:

	1919	1920
Male	91.3	73.6
Female	67.1	68.1

No explanation is offered for the greater discrepancy in 1919.

Grouping by race, nativity of parents, age group, and calendar months, has not been done.

Causative factors and comparisons with those of the United States registration area for 1919 are shown in the following table:

Cause of death.	United States registration area, 1919.	Montana.	
		1919	1920
	Per cent.	*Per cent.*	*Per cent.*
Natal and prenatal causes	42.7	51.2	52.9
Gastrointestinal diseases	20.5	11.5	14.1
Respiratory diseases	14.6	16.3	14.7
Epidemic diseases	9.7	12.4	11.5
All other diseases	12.5	8.6	6.8

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[7] Admitted to birth registration area, 1920.

Climatic conditions for the most part are most favorable for infant hygiene. While a somewhat prolonged winter season, with its tendencies to closed windows and restricted ventilation, might be thought to be productive of decreased resistance to respiratory infection, such is not actually shown. In fact, the proportion of these infections in both years is actually higher than normal, owing to annual recrudescenses of influenza. Summer temperatures are most conducive to low rates of gastrointestinal disorders and heat exhaustions.

The two factors in which the proportions annually and strikingly exceed those of the United States registration area are those most subject to control and which distinctly call for the greatest exercise of preventive measures, viz, epidemic diseases and natal and prenatal causes. They call for energetic educational campaigns.

STILLBIRTHS.

The term "stillbirths" is admittedly unsatisfactory, including as it does "*premature* stillbirths" and "*mature* stillbirths." Under Montana regulations certificates are required for all stillborn children that have passed the fourth month (or sixteenth week) of gestation, a variation from the standard of the seventh month (or twenty-eighth week) in effect in many States. Many physicians are frank in stating that they classify stillbirths under the seventh month as "miscarriages" or "abortions" and do not regard them as reportable. It is accepted that the great majority of stillbirths in the two years exceeded the seventh month. In considering "stillbirth rates," these qualifications must be kept in mind.

In the table following two ratios are given: (1) The ratio of stillbirths to 1,000 living births, and (2) the ratio of stillbirths to 1,000 known pregnancies, i. e., living and stillbirths both included.

	1919			1920		
	Total number of stillbirths.	Stillbirths per 1,000 pregnancies.	Stillbirths per 1,000 living births.	Total number of stillbirths.	Stillbirths per 1,000 pregnancies.	Stillbirths per 1,000 living births.
Urban	172	33.8	34.9	206	39.6	41.1
Rural	187	25.7	26.4	170	24.2	24.8
Total	360	29.1	29.9	376	30.7	31.7

In 1919 stillbirths occurred in 2.9 per cent of known pregnancies, and in 1920 in 3.1 per cent of known pregnancies.

Hospital experience is not fairly comparable to general practice, but the following permits of some comparison:

Sloane Hospital, New York,[8] reports 4.29 per cent of stillbirths in a series of 10,000 confinements. In the same article reference is made to a stillbirth rate of 5.22 per cent experienced by Kerness, of Munich.

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[8] Holt and Babbitt, Journal A. M. A., Jan. 23, 1915.

The New York Infirmary for Women and Children [9] reports a stillbirth rate of 3.6 per cent in 3,416 confinements.

H. Schwarz, New York,[10] in a series of 27,711 pregnancies in 6,968 families, found a stillbirth rate of 1.49 per cent, but makes additional segregation of 8.8 per cent of miscarriages.

The New York Milk Commission reports 3.65 per cent of stillbirths in 3,145 confinements in the Borough of Manhattan, 1912 to 1916, all mothers having been given special prenatal instruction.

Chambrelent, of Bordeaux, refers to a prevailing rate in France of 4.7 per cent of stillbirths during 1910.

Omitting the rate given by Schwarz, which seemingly refers to "mature stillbirths," the average rate of this group is 4.2 per cent; and inasmuch as the rate in general practice may be expected to exceed that of hospitals, no less than 4.5 per cent may be accepted as an average rate. A survey for 1919 conducted by the Metropolitan Life Insurance Co.[11] in States and cities with acceptedly good birth registration confirms this estimate. On this basis an average of two-thirds of stillbirths in the State are annually reported.

The greater urban rate may be partially but not entirely accounted for by better reporting and by the tendency of cases of expected dystocia to seek hospital attention.

No study has been made of causative factors; but since these are so generally established, and since the application of preventive measures is more or less standardized, it seems unnecessary to extend such study to this small group.

MATERNAL DEATHS.

Deaths from the puerperal state in 1919 numbered 142, and in 1920, 118. In apparent ratio to population, deaths from these causes have been consistently high, although due allowance must be made for the influenza and pneumonia waves extending from 1917 to 1919, with slight recurrence in the spring of 1920.

	Maternal deaths.		Maternal deaths.
1910	63	1916	108
1911	78	1917	143
1912	75	1918	184
1913	80	1919	142
1914	100	1920	118
1915	91		

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[9] Mary Lee Edward, Journal A. M. A., Oct. 16, 1915.

[10] American Journal Diseases of Children, April, 1920.

[11] Statistical Bulletin, Metropolitan Life Insurance Co., March, 1920.

This is equivalent to a rate of 26.3 per 100,000 population in 1919, and of 21.1 in 1920. The highest average rate recorded among 16 civilized nations for the period 1900–1910 was 19.6 in Spain, the lowest, 6, in Sweden; and for the United States registration area during the same period it was 14.9.[12]

The rate per 100,000 females of child-bearing age (15–44 years) in 1919 was 116.6, and in 1920, 98. Among 11 European countries, during the prewar period (i. e., 1910 to 1913), the highest rates recorded were those of Belgium, 63.79 in 1912, and of Scotland, 62.24 in 1913, and the lowest, that of Sweden, 29.3 in 1910, and of Norway, 31.96 in 1910. Among the death registration States for the period 1910 to 1915, inclusive, the Montana rate was conspicuously in excess of all others with the exception of only one year, that of 1910, when the Colorado rate, 80.5, exceeded Montana's rate of 78.9.[12]

The rate per 1,000 living births in 1919 was 11.8, and in 1920, 9.9. The highest rate recorded among 15 foreign countries in 1910 (a prewar period) was that of Scotland, 5.7, the lowest that of Italy, 2.4.[12] The rate for the United States birth registration area for 1919 was 7.4. The highest rate, 11.2, was recorded in South Carolina, and the lowest, 4.8, in Wisconsin. Comparisons for 1920 are not available at the time of this writing.

Maternal death rates per 1,000 living births, 1919.

United States Birth Registration Area, 7.4.

Montana [13]	11. 8	New Hampshire	8. 0
South Carolina	11. 2	Vermont	8. 0
Oregon	10. 1	Michigan	7. 7
North Carolina	9. 3	Ohio	7. 4
Maine	8. 6	Massachusetts	7. 1
Washington	8. 6	Pennsylvania	6. 8
Indiana	8. 4	Minnesota	6. 7
Maryland	8. 4	Kentucky	6. 3
Utah	8. 4	Connecticut	6. 2
Kansas	8. 2	New York	6. 2
Virginia	8. 2	Wisconsin	4. 8
California	8. 0		

Although birth reporting in Montana for the period 1910 to 1920 has not been complete, it has been sufficient to confirm the opinion that the maternal death rates for 1919 and 1920 have been fairly constant during the decade:

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[12] Appendix A, Rural Child Welfare Series No. 3, Pub. No. 34, Children's Bureau, U. S. Department of Labor.

[13] Montana (1920), 9.9.

	Maternal death rate per 1,000 live births.
1910	10.3
1911	10.3
1912	9.2
1913	9.2
1914	10.0
1915	8.1
1916	([14])
1917	10.9
1918	12.8
1919	11.8
1920	9.9

It can be accepted, therefore, that Montana has an unenviable maternal death rate. Analysis of maternal deaths for the two years discloses some interesting facts. The ratios given are per 1,000 living births.

The urban rate for 1919 was 12.7, the rural, 11.1. Excluding 19 rural cases imported into urban centers for hospital care and including them as rural, the urban rate is reduced to 8.9, and the rural increased to 13.8.

The urban rate for 1920 was 9.98, the rural, 9.92. Excluding 17 rural cases imported to urban hospitals, the urban rate is reduced to 6.6 and the rural increased to 12.4.

In the absence of the standard birth certificate during 1919, nativities can not be given for that year; but for 1920 the rate among native-born women was 10.7, among the foreign-born, 6.8.

For 1919 the rate among white women was 11.7, among Indians 19.6. For 1920 the rate for whites was 10.1, among Indians 5.96. The small numbers of Indian births and deaths accounts for the wide fluctuation. No maternal deaths were recorded among Negroes, Chinese, or Japanese. These, too, constitute a small portion of the female population.

Deaths by age groups are as follows:

Years of age.	1919	1920
15-19	8	7
20-24	20	26
25-29	34	29
30-34	39	22
35-39	23	23
40-44	16	9
45-49	1	1
50-59	0	1
Total	142	118

Deaths, by conjugal condition, were:

	1919	1920
Single	3	2
Married	136	115
Widowed	1	1
Divorced	2	0

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[14] Birth data not tabulated.

Illicit pregnancies seem to have constituted a small per cent. If we admit that any number of such are camouflaged under other diagnosis as to cause of death we must confess to higher maternal rates than are actually shown.

Specific causes of maternal deaths are shown in the following table.

Cause. (International List of Causes of Death.)	1919	1920	Total.
134. Accidents of pregnancy	12	15	27
135. Puerperal hemorrhage	12	14	26
136. Accidents of labor	27	19	46
137. Puerperal septicemia	57	45	102
138. Puerperal albuminuria and convulsions	18	18	36
139. Puerperal phlegmasia and embolism	12	7	19
140. Following childbirth	4	0	4
141. Puerperal diseases of breast	0	0	0
Total	142	118	260

The rates (per 1,000 living births) by groups for the two years as compared with those of the United States registration area for 1919 were:

	Registration area, 1919.	Montana.	
		1919	1920
All puerperal causes	7.4	11.8	9.9
Puerperal septicemia	2.5	4.7	3.8
All other causes	4.9	7.1	6.1

Analysis of complicating or causative factors is shown in the following table.

Causative or complicating factors of puerperal deaths.

Cause or complicating factor.	Puerperal septicemia.			Other causes.			Total.		Total, both years.
	1919	1920	Total.	1919	1920	Total.	1919	1920	
Abortion (or miscarriage) [15]	26	22	48	4	7	11	30	29	59
Cæsarian section	1	......	1	1	3	4	2	3	5
Embolism	......	......	......	11	6	17	11	6	17
Extra uterine pregnancy	1	......	1	4	1	5	5	1	6
Influenza	6	1	7	25	14	39	31	15	46
Intestinal lesions	......	2	2	......	1	1	......	3	3
Inversion of uterus	......	......	......	1	......	1	1	......	1
Meningitis	......	......	......	1	......	1	1	......	1
Nephritis (acute or chrónic)	......	......	......	3	4	7	3	4	7
Organic heart disease	......	......	......	1	2	3	1	2	3
Pernicious vomiting	......	......	......	......	4	4	......	4	4
Phlebitis	......	......	......	1	1	2	1	1	2
Placenta previa	......	......	......	2	3	5	2	3	5
Pneumonias	1	......	1	2	6	8	3	6	9
Shock and exhaustion	......	......	......	5	2	7	5	2	7
Toxemia (no other cause assigned)	......	......	......	14	12	26	14	12	26
Uterine rupture or laceration	......	......	......	3	......	3	3	......	3
Childbirth (no other cause assigned)	22	20	42	7	7	14	29	27	56
Total	57	45	102	85	73	158	142	118	260

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[15] One-third of these were said to have been self-induced.

RESPONSIBILITY OF OBSTETRICIANS.

To what extent are infant and maternal deaths due to defects of obstetrical practice or to absence of any obstetrical attendance? Let us consider first the physical limitations.

The total average number of physicians in the State for the years 1919 and 1920 was 653. A certain number of these engaged in specialties and did not respond to obstetrical or general practice calls. According to birth certificates filed, the number actually engaged in midwifery in 1919 was 583, of which number 182 were located in urban centers and 401 in rural sections. The average population served by each physician was 942, or 945 for urban physicians and 940 for rural physicians; though, of course, each urban physician served a considerable rural group in addition to his urban quota.

The number of physicians engaged in midwifery in the State was reduced in 1920 to 572, of which 205 were urban and 367 rural. Each served an average population of 960, or 839 for each urban physician and 1,027 for each rural physician.

The territory over which practice extended averaged 250 square miles for each physician, varying from 12.3 square miles in Silver Bow County to 2,418 square miles in Garfield County.

Supplementing obstetrical attendance by physicians, there were, in 1919, 147 midwives, and in 1920, 190 midwives. The term "midwife" is used elastically; and as Montana has no laws regulating or licensing midwives, except to specify their duties in the reporting of births, the definition includes every person from the practical nurse who makes a profession of attending obstetrical cases, to the neighbor who volunteers service when emergency demands. They flourish mainly in remote corners where physicians are not available or available only at great expense. The actual percentage of cases attended by them, as shown in the following paragraphs, is not great, and constitutes but a small part of the problem of the reduction of infant and maternal deaths. However, it is a part which must be met by efforts toward education of these "midwives" and their elimination by supplying medical aid in those districts in which great need has contributed to the survival of the midwives.

Of the 12,017 births reported in 1919, 11,489 were attended by physicians, 401 by midwives, and 127 had no attendance. Of those who had attendance, 96.6 per cent employed physicians, and 3.4 per cent midwives, an average of 19.7 births for each physician and 2.7 births for each midwife. The average number of births attended by each urban physician was 27.1 and by each rural physician 17.6.

Of the 11,682 births reported in 1920, 11,096 were attended by physicians, 399 by midwives, and 367 reported no attendants. Of those who had attendance, 96.5 per cent employed physicians and 3.5 per cent employed midwives, an average of 19.4 births for each physician and 2.1 births for each midwife. The average number of births attended by each urban physician was 24.4 and by each rural physician 18.7.

The economic depression in agricultural districts in 1920, following the severe drought of 1919, is reflected in (1) the decrease in the number of physicians and especially of rural physicians, with a consequent increased population quota for each rural practitioner; (2) the decrease in the average number of births attended by urban physicians and an increase attended by rural physicians, owing to lack of funds to finance hospital attention; (3) the increase in the total number of midwives through inability of some of the people to pay physician's fees; and (4) the increase in the number of cases who could afford no attendance by either physician or midwife.

On account of lack of clerical help, analysis of the certificates of infant deaths has not been possible, but the following data regarding maternal deaths shed some light on the question of whether any of the fault lies with modern obstetrical practice.

These deaths occurred by months as follows:

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1919	19	10	15	19	12	7	11	8	7	9	11	14	142
1920	10	30	14	9	4	7	6	7	6	6	11	8	118
Total	29	40	29	28	16	14	17	15	13	15	22	22	260

The months from November to April, inclusive, constitute that period when communication, especially rural, is likely to be most difficult, and in remote areas entirely interrupted at times. Deaths during this period constitute 65.4 per cent of the total number. Although influenza recurrences during the early part of both years manifested some influence, it seems evident that the factors of difficult travel and communication, with consequent inability or delay in securing prompt medical attention, must be considered as contributory to a high maternal mortality.

Since, under vital statistics regulations, midwives are not authorized to sign death certificates, no maternal deaths are reported as having occurred under their attention, all such certificates having been signed, in the absence of an attending physician, by coroners, and are classified in the following table as "deaths with no medical attendance."

Deaths from puerperal state.

Cause. (International List of Causes of Death.)	Attended by physician.		No medical attendance.	
	1919	1920	1919	1920
134. Accidents of pregnancy	12	15	0	0
135. Puerperal hemorrhage	6	12	6	2
136. Other accidents of labor	23	14	4	5
137. Puerperal septicemia	53	45	4	0
138. Puerperal albuminuria and convulsions	18	16	0	2
139. Puerperal phlegmasia and embolism	11	7	1	0
140. Following childbirth	4	0	0	0
141. Puerperal diseases of the breast	0	0	0	0
Total	127	109	15	9

It is to be noted that 90.8 per cent of the total for the biennium secured medical attendance; but it is the length of such medical attendance that serves to guide opinion as to the culpability for these deaths. The following table is more or less self-explanatory. It should be remembered that deaths occurring over 30 days after childbirth are not classified as maternal deaths, and the length of time quoted refers to the entire period of attendance prior to and for one month after parturition.

Length of medical attendance in maternal deaths, 1919-1920, in cases attended by physician.

	Puerperal septicemia.	All other causes.	Total.		Puerperal septicemia.	All other causes.	Total.
1 day or less	17	46	63	1 to 2 months	1	8	9
2 days	8	14	22	2 to 3 months	0	2	2
3 days	3	3	6	4 to 6 months	0	2	2
4 to 7 days	41	38	79	7 to 8 months	0	1	1
8 to 14 days	23	17	40				
15 to 30 days	5	7	12	Total	98	138	236

It would appear from these tables that of the 260 persons in whom death occurred from puerperal causes during the biennium, only 14, or 5.4 per cent, had methodically subjected themselves to consistent prenatal care, instruction, or examination from the attendant called at the time of childbirth.

It is not to be inferred that 94.6 per cent of *all* mothers in Montana are neglected in the matter of prenatal care and instruction; but that percentage would seem to apply to those who died, and at least 246 mothers suffered as a penalty for this neglect.[16]

Doubtlessly, careless obstetrical method plays its part, and a not unimportant one, in deaths of both mothers and infants; but no amount of faultless technique can repair or anticipate organic defects and damage wrought by months of neglect.

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[16] "It is not surprising that in the remote area studied, where there has been no such propaganda (i. e., for prenatal care), more than three-fourths of the mothers had no prenatal care whatever—saw no physician, had no physical examination, measurements, or urinalysis." (Page 37, Maternity Care and Welfare of Young Children in a Homesteading County in Montana, United States Children's Bureau Publication No. 34, Rural Child Welfare Series No. 3, by Viola I. Paradise.)

The problem confronting the medical profession is not only that of reducing the number in its own ranks of those who are incompetent, unfitted, careless, or criminal in the care and treatment of motherhood, but in being able to teach, through social agencies, the duty imposed upon the expectant mother, of making a scientific preparation for the ordeal—an ordeal which involves not only life for herself and her infant, but the welfare of the family. Communities must be brought to realize their responsibility in providing lying-in facilities such that no mother, in whatever social condition need suffer for lack of them.

The life of the pioneer has ever been one of hardships and perils; but with modern means of transportation, of knowledge, and of social charity, it should be possible to materially reduce the unnecessary losses which Montana has uncomprehendingly suffered in her years of development.

A SURVEY OF NATURAL ILLUMINATION IN AN INDUSTRIAL PLANT.

With Special Reference to the Use of the Indoor-Outdoor Ratio in Establishing Standards of Daylight Illumination.

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Considerable attention has been devoted during the past few years to the study of the result of artificial illumination in factories, and adequate and satisfactory standards for judging such illumination have been prepared and placed in force.[1] So far as we are aware very little attention has been paid to the study of illumination under daylight conditions. It may, therefore, be of interest to present the results of a somewhat careful survey conducted during the war in a large munition factory in Connecticut with a special view to the development of standard procedures adapted for this type of survey.

A. GENERAL PHYSICAL CONDITIONS.

The plant in question was a large one, including nearly 150 workrooms. Its buildings were of two main types—the older ones of brick, receiving their natural illumination by means of ordinary sash windows with plain glass; the newer ones, of concrete, provided with fenestral windows of wire glass (mostly ribbed to diffuse the light as far as possible).

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[1] Bell, Louis: Industrial Lighting Codes. J. Ind. Hyg., vol. 2, p. 183.